ORIGINAL ARTICLE

Predictors of Dependency on Nursing Care After Stroke

Results From the Dortmund and Münster Stroke Registry

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SUMMARY

Background: The long-term effects of stroke have been inadequately studied. We identified social and clinical factors that were associated with application for insurance payments for long-term care within 3.6 years after stroke.

Methods: In a quality-assurance project called “Stroke Northwest Germany,” information was obtained from 2286 stroke patients on their socio-demographic background, type of stroke, comorbidities, and degree of physical impairment during their hospital stay, as measured on the Rankin Scale, the Barthel Index, and the Neurological Symptom Scale. We used logistic regression models to identify possible associations between these factors and application for insurance payments for long-term care within 3.6 years after stroke. We developed an appropriate prognostic model by means of backward selection.

Results: 734 (32.1%) of the patients participated in follow-up and reported whether they had applied for insurance payments for long-term care. 22.5% had submitted an application. The rate of application was positively correlated with age, female sex, the number of comorbidities and complications during hospitalization, and the degree of physical impairment.

Conclusion: Stroke has major long-term effects. The probability that a stroke patient will apply for insurance payments for long-term care is a function of the patient's age, sex, previous stroke history, and physical impairment as measured on the Rankin Scale and the Barthel Index.

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Each year around 196 000 people in Germany suffer their first stroke (1). Most of these strokes, around 78.7%, are due to cerebral ischemia. Of the remainder, 12.6% are caused by cerebral hemorrhage and 2.7% by subarachnoid hemorrhage; 6.0% are classified as stroke of unknown origin (2). It is important to distinguish these principal types of stroke because they differ greatly in terms of mortality, disability, and dependency on care.

Across the world, stroke is one of the diseases with the most wide-reaching social and medical consequences. In Germany, stroke is the fourth most frequent cause of death in women and the fifth in men. Mortality has decreased considerably since the early 1990s, but still about 30% of stroke patients die within a year of the event. Furthermore, many patients suffer long-term neurological consequences, foremost among them paralysis, speech disorders, cognitive impairments, depression, and urinary and fecal incontinence (3). The persisting symptoms combine to impair the functions of daily life in many ways. Stroke is one of the principal reasons for dependency on nursing care among adults.

Apart from the far-reaching health-related consequences, stroke is responsible for costs of more than € 15 000 per patient in the first 3 months after the event and is thus one of the most cost-intensive diseases in the German health-care system (4). A large proportion of the expenditure goes on rehabilitation (€ 1.5 billion) and nursing care (€ 1.7 billion) (5).

In contrast to the wealth of information on acute care of stroke patients that has been amassed by virtue of standardized documentation in long-established regional quality-assurance projects (6), data on the course of the disease after discharge from hospital or following rehabilitation are sparse. In particular, there is a shortage of data on the proportion of patients who apply for nursing care according to section XI of the German Social Code and on the predictors of such claims.

The primary goal of our study was therefore to analyze the impact of clinical and social factors on the probability of subsequent application for services covered by the patients' nursing care insurance. A secondary goal was to ascertain what health-related

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TABLE 1
Influence of sociodemographic factors, type of stroke, and type of ward on subsequent application for nursing care (adjusted for age and sex)

	Number of patients	Application made	Proportion (%)	OR (95% CI)*
N	734	170	23.2	
Sex				
- Men	438	82	18.7	1.00
- Women	296	88	29.7	1.73 (1.21–2.46)
Age at baseline			Per year of life	1.04 (1.03–1.06)
≤ 49 years	62	7	11.3	1.00
50–59 years	105	13	12.4	1.15 (0.43–3.08)
60–69 years	265	59	22.3	2.40 (1.03–5.58)
70–79 years	220	56	25.5	2.91 (1.25–6.81)
≥ 80 years	82	35	42.7	5.43 (2.20–13.42)
Level of education				
General secondary school (Hauptschule)	351	84	23.9	1.00
Intermediate secondary school (Realschule)	87	19	21.8	0.91 (0.51–1.63)
University entrance qualification	34	6	17.7	0.90 (0.35–2.32)
University	51	6	11.8	0.51 (0.21–2.26)
Occupational qualification				
None	90	26	28.9	1.00
Apprenticeship	321	79	24.6	0.95 (0.55–1.63)
Higher qualifications	58	5	8.6	0.28 (0.10–0.81)
Home situation				
With partner	395	78	19.8	1.00
Living alone	131	42	32.1	1.37 (0.84–2.23)
With family	47	11	23.4	1.08 (0.51–2.29)
Institution	6	5	83.3	12.87 (1.43–114.21)
Stroke type				
TIA	178	28	15.7	1.00
Cerebral ischemia	511	130	25.4	1.99 (1.23–3.16)
Cerebral hemorrhage	29	7	24.1	1.85 (0.71–4.83)
Other, unknown	16	5	31.3	1.97 (0.60–2.58)
Ward				
General	314	65	20.7	1.00
Stroke unit	344	85	24.7	1.31 (0.90–1.91)
Intensive care	16	6	37.5	2.44 (0.82–7.25)
Observation	33	6	18.2	1.39 (0.58–3.39)

OR, Odds ratio; 95% CI, 95% confidence interval; TIA, transient ischemic attack;
*adjusted for age and sex, except for the variables age (adjusted only for sex) and sex (adjusted only for age)

TABLE 2

Influence of comorbidity during hospital stay on subsequent application for nursing care following a stroke

Comorbidities		Number of patients (n)	Application made (n)	Proportion (%)	OR (95% CI)*
Diabetes mellitus	–	521	104	20.0	1.80 (1.22–2.63)
	+	196	63	32.1	
Hypertension	–	133	24	18.1	1.07 (0.64–1.79)
	+	588	143	24.3	
Myocardial infarction	–	650	148	22.8	1.10 (0.58–2.16)
	+	59	14	23.7	
Symptoms of ICA stenosis	–	599	132	22.0	1.68 (1.02–2.76)
	+	98	29	29.6	
Atrial fibrillation	–	561	116	20.7	1.42 (0.93–2.17)
	+	144	47	32.6	
Heart failure	–	554	120	21.7	1.16 (0.76–1.78)
	+	153	43	28.1	
Previous stroke	–	579	117	20.2	2.04 (1.33–3.12)
	+	133	47	35.3	
Pulmonary disease	–	638	144	22.6	1.43 (0.80–2.55)
	+	69	19	27.5	
Psychiatric/neurodegenerative disease	–	681	151	22.2	2.24 (0.97–5.17)
	+	25	11	44.0	
Number of comorbidities*				Per comorbidity	1.33 (1.16–1.54)
0		76	8	10.5	1.00
1		215	33	15.4	1.12 (0.48–2.61)
2		207	52	25.1	1.96 (0.85–4.52)
3		147	47	32.0	2.75 (1.17–6.46)
≥ 4		89	30	33.7	2.90 (1.17–7.19)

OR, Odds ratio; 95% CI, 95% confidence interval; ICA, internal carotid artery; * adjusted for age and sex

instruments are best suited to predict subsequent application for nursing care at the time of discharge from hospital.

Methods

Between October 2003 and June 2006, a total of 2286 stroke patients were enrolled in this exploratory study in the framework of the quality-assurance project “Stroke Northwest Germany” (7). These patients were recruited from six hospitals in Dortmund and from Münster University Hospital. Stroke Northwest Germany is a regional project that forms part of the network “German Stroke Registry Study Group”.

Documentation during the patients’ stay in hospital is standardized and records among others the following:

- Sociodemographic data
- Type of stroke
 - Transient ischemic attack (TIA)

- Cerebral ischemia
- Cerebral hemorrhage
- Unknown or other

- Comorbidities
- Complications during treatment
- Type of ward

At the time of discharge from hospital, the degree of physical functional impairment was assessed by means of the Rankin Scale and the ability to perform daily activities without assistance was measured using the short version of the Barthel Index. A “Neurological Symptom Scale” summarized four neurological symptoms: paralysis of arm or hand, paralysis of leg or foot, speech disorders, and coma state.

At a mean of 3.6 years (range: 2.1–5.1 years) after the stroke event, patients were interviewed in person about their home situation, physical functional capacity, visits to the doctor, and chronic illnesses, and their responses were recorded on a questionnaire. They were

TABLE 3

Association between physical functional capacity at time of discharge and subsequent application for nursing care following a stroke

Neurological Symptom Scale		Number of patients (n)	Application made (n)	Proportion %	OR (95% CI)*
Impairment, arm/hand	–	511	92	18.0	2.55 (1.76–3.68)
	+	223	78	35.0	
Impairment, leg/foot	–	590	109	18.5	3.36 (2.24–5.05)
	+	144	61	42.4	
Speech disorders	–	609	123	20.2	2.43 (1.59–3.73)
	+	126	47	37.6	
Coma	–	652	149	23.2	–
	+	0	0	0	
Number of neurological symptoms				Per symptom	1.77 (1.48–2.10)
0		449	77	17.2	1.00
1		128	27	20.1	1.18 (0.71–1.96)
2		107	39	36.5	2.90 (1.79–4.71)
3		50	27	54.0	6.22 (3.30–11.72)
Barthel Index				Per 12.5 points	1.04 (1.03–1.05)
100		459	65	14.5	1.00
99–75		81	29	35.8	3.04 (1.77–5.21)
≤ 74		73	49	67.1	12.75 (7.19–22.62)
Rankin Scale				Per category	1.93 (1.65–2.25)
No symptoms		186	18	9.7	1.00
No essential disability		148	24	16.2	1.74 (0.89–3.38)
Slight disability		143	35	24.5	2.74 (1.46–5.15)
Moderate disability		87	29	33.3	4.59 (2.33–9.01)
Moderately severe disability		44	28	63.6	17.12 (7.65–38.34)
Severe disability		17	13	76.5	34.60 (9.68–38.34)

OR, Odds ratio; 95% CI, 95% confidence interval; ICA, internal carotid artery; * adjusted for age and sex

also asked whether they had applied for services covered by their nursing care insurance. Patients who could not attend for interview received the questionnaire by post or were interviewed by telephone. At the end of the study period we ascertained whether the patients were alive or dead and in the latter case recorded the exact date of death.

Statistical analysis

Differences between participants in the follow-up survey and those who did not participate were tested with the chi-square test for categorical data and with the Wilcoxon rank sum test for controlled variables.

The influence of individual factors (independent variables) on the likelihood of a subsequent application for nursing care (yes/no) as dependent variable was

investigated by logistical regression analysis. We adjusted for age and sex in all models.

We then used a multivariate logistical regression model to analyze what factors present at the time of discharge predict subsequent application for nursing care. The choice of a suitable explanation model was based above all on the desire to cover the highest possible proportion of the variance in the likelihood of an application for nursing care with a small number of variables. To this end, all individual variables that, independently of each other, showed an influence on such an application were investigated together in a regression model. The backward selection method was then used to reduce the model to those variables that contributed to explaining the application.

TABLE 4

Development of a suitable model for prediction of subsequent application for nursing care

	OR	95% CI
Female sex	1.80	1.15–2.83
Age (per year)	1.04	1.02–1.06
Previous stroke	2.29	1.38–3.81
Rankin Scale (per unit)	1.48	1.20–1.84
Barthel Index (per unit)	0.98	0.96–0.99
Goodness-of-fit test:		
Pearson chi-square test	= 409.5	
p value	= 0.46	

Results

Comparison of study participants

Of the 2286 stroke patients recruited, 756 (33.1%) could be contacted with regard to the follow-up survey. Of the remainder, 617 patients (27.0%) had died and 913 (39.9%) were difficult to contact. Of the patients contacted, 564 (74.6%) had not applied for nursing care an average of 3.6 years after their stroke, while 170 patients (22.5%) had submitted an application for care. The remaining 22 patients (2.9%) did not answer this question. Thus data on 734 persons were available for analysis.

Of the 170 applications, 123 were approved. Seventy-three of these patients (59.3%) received level 1 nursing care, 42 patients (34.1%) level 2 care, and 8 patients (6.5%) level 3 care. Forty stroke patients had their applications turned down, and for seven participants no information on approval/rejection was available. Patients for whom data on application for nursing care were available were younger by a mean 5.4 years than those who had only taken part in the inpatient part of the study, and a significantly higher proportion of them were men. Furthermore, the patients who participated in the follow-up survey were more frequently living with a partner than those who did not, and the former had more often had a TIA (*eTable 1*).

Sociodemographic parameters

Age and sex showed an influence on the likelihood of a subsequent application for nursing care (*Table 1*). Women were 1.7 times more likely than men to apply. For both men and women the likelihood of an application increased by 4% per year of age, so that patients ≥ 80 years were 5.4 times more likely to apply than those ≤ 49 years.

With regard to education and occupational qualification, particularly patients with a high level of education were unlikely to apply for nursing care. Regarding individual home situation, only patients who were already living in an institution at the time of their stroke were, as expected, much more likely to apply.

Differences could also be discerned between patients with different types of stroke. Patients with cerebral ischemia were almost twice as likely (odds ratio [OR]: 1.99) to apply for nursing care as those with a TIA. A similar, albeit non-significant, increase in likelihood was seen for patients with cerebral hemorrhage (OR: 1.85).

Comorbidity

Patients who suffer a stroke frequently have other chronic illnesses that increase the probability of a subsequent application for nursing care. The rate was twice as high (OR: 2.04) in those who had had a previous stroke. Patients with diabetes mellitus (OR: 1.80) and those with a symptomatic stenosis of the internal carotid artery (OR: 1.68) were more likely to make an application (*Table 2*).

Multimorbid patients, i.e. those with three (OR: 2.75) or four or more (OR: 2.90) concurrent diseases-

respectively, were almost three times as likely to make an application for nursing care as those without comorbidity. Every additional disease increased the likelihood by 33.0%.

Treatment course

With regard to the influence of medical complications that arise during the treatment of stroke patients, it must be pointed out that they are related first and foremost to the patients' poor general condition. Urinary tract infections (OR: 3.81), pneumonia (OR: 3.89), previous stroke (OR: 3.30), and falls (3.71) were therefore linked with a three- to fourfold increase in the likelihood of application for nursing care. Patients who showed signs of disorientation during their stay in hospital had a particularly high probability of applying for care later. Every additional medical complication increased the likelihood 2.9-fold (*eTable 2*).

Functional impairment

As could be expected, there was an association between physical functional status at the time of discharge and the likelihood of a subsequent application for nursing care. Patients who displayed functional impairments in the legs or feet made an application 3.3 times as often as those with no such deficits. For patients with speech disorders or impairments in the arms or hands, the likelihood was raised around 2.5-fold. Similar associations were found for the other standardized measures of physical function. Patients with a Barthel Index score of between 99 and 75 points, showing a less than optimal state of health, were more than 3 times as likely to apply for care. Those who scored fewer than 75 points were 12.8 times as likely to make an application. The Rankin Scale also showed an association between increasing functional impairment and the probability of a subsequent application for care (*Table 3*).

Prognosis for a subsequent application for nursing care

The likelihood of a subsequent application for nursing care can be predicted at the time of inpatient treatment on the basis of the following factors (*Table 4*):

- Age
- Female sex
- A previous stroke
- A high score on the Rankin Scale
- A low score on the Barthel Index

According to the likelihood ratio test, all other factors, e.g., type of stroke, number of comorbidities, or the neurological symptoms at hospital discharge, do not contribute to further improvement of the explanation model ($p < 0.00$). Overall, the final model incorporating the five factors listed above has a Pearson chi-square value of 409.5 ($p = 0.46$) and thus displays good prognostic validity.

Discussion

This study of a cohort of stroke patients from Dortmund and Münster identified various risk factors

for subsequent dependency on nursing care. The likelihood of such dependency is 1.7 times higher in women than in men, and in both sexes the probability increases by about 4% with each year of age. Moreover, stroke patients with cerebral ischemia are also twice as likely to apply for nursing care as those with a TIA. Patients with comorbidities, medical complications during treatment, or functional impairments at the time of hospital discharge have a distinctly greater probability of dependency on nursing care. Those with moderate or severe disabilities (Rankin Scale) are at particularly high risk.

Other investigators have also studied the determinants of disease course following a stroke. They all agree that advanced age is the factor with the greatest influence: on the later requirement for support (8), cognitive impairments (9), duration of hospital stay (10), and death (11). A German secondary data analysis of persons with statutory health insurance cover (Gesetzliche Krankenversicherung, GKV) showed that after age 40, the risk of dependency on nursing care 1 year after a stroke increases by 13% with every additional year of life (12). The far lower age-related increase in the patients from Dortmund and Münster (4% per additional year of life) can be attributed to participation of younger and healthier patients in our follow-up survey.

The GKV analysis agrees with the present study in showing a difference between the sexes in the likelihood of dependency on nursing care: 1 year after a stroke, women have a 41% higher risk than men (12). This may be partly related to age, in that women live longer than men and are on average 4 years older than men at the time of their first stroke (13). When a woman has a stroke her partner has often already died, and women living alone are particularly likely to be dependent on external nursing care. Overall, however, international findings on the influence of the patient's sex on the disease course after a stroke are inconsistent. In many studies, after adjustment for age there is no longer any significant association between sex and a bad prognosis (8, 14). On the other hand, complex medical procedures such as diagnostic cardiac ultrasonography or other imaging procedures and carotid surgery are performed more frequently in men than in women after a stroke (15).

Apart from higher age, low socio-economic status also worsens the long-term prognosis with regard to disability and death (16, 17). Heavy physical labor and very low income exert a particularly negative influence (18). The results of the present study show a similar though non-significant association.

Analysis of data from the Dortmund and Münster Stroke Registry reveals the negative influence of various comorbidities on the disease course after a stroke. This agrees with recent findings that patients with cardiac arrhythmia, diabetes mellitus, high blood pressure, peripheral arterial occlusive disease, and depression have poorer prospects of recovery after a stroke (11,

19–21). In Germany, the Erlangen Stroke Project investigated the outcome in patients with cerebral ischemia of various origins. Patients with cerebral ischemia caused by microangiopathy were found to have a lower risk of dependency on nursing care than those with ischemia of other causes, such as cardioembolism.

Repeated attempts have been made to establish a reliable means of predicting the long-term prognosis for stroke patients on the basis of the short-term cognitive and physical impairments. Three instruments in particular have been validated and are thus being used with increasing frequency: the modified Rankin Scale (11, 21, 23) for evaluation of the neurological deficits after a stroke, the Barthel Index (9, 24), and the Glasgow Coma Scale (8, 14) for assessment of the state of consciousness. Survival time and risk of disability have mainly been used as dependent variables.

Our analysis of data from the Dortmund and Münster Stroke Registry has now shown that both the Rankin Scale and the Barthel Index are suitable instruments for predicting the long-term risk of dependency on nursing care after a stroke. The two scales in combination, reinforced by data on the patient's age and sex and clarification of whether the stroke was a first event or a re-insult, display high prognostic validity. It should be noted that only a few of the large number of temporally associated factors actually have a significant influence on the likelihood of a subsequent application for services covered by the patient's nursing care insurance.

One major limitation of our study is the potential selection effect in the recruitment phase and again at the time of follow-up. First, it was difficult to recruit patients who were in a coma or very old with no spouse. Second, 27% of the patients recruited had died by the time of follow-up, and 40.9% of those who were still alive could not be contacted, so we had no means of knowing whether they had applied for nursing care. It is therefore probable that the results of the survey were distorted by selection of younger, married, and male patients who had suffered one of the less severe forms of stroke, e.g., a TIA (*eTable 1*). This must be considered before extrapolating the findings to other groups of stroke patients.

Overall, however, this prospective survey of patients at a mean 3.6 years after their stroke event makes a valuable contribution to the body of knowledge on the factors affecting the evolution after a stroke.

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Conflict of interest statement

The authors declare that no conflict of interest exists.

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KEY MESSAGES

- The probability of applying for services covered by nursing care insurance rises by around 4% with every year of age.
- Women are 1.7 times more likely than men to apply for nursing care.
- Patients with stroke caused by cerebral ischemia are almost twice as likely (odds ratio: 1.99) to make an application as patients who have suffered a transient ischemic attack.
- Multimorbid patients, i.e., those with three or more concurrent diseases, are almost three times as likely to apply for nursing care as patients with no comorbidities; each additional disease increases the likelihood by 33%.
- Advanced age, female sex, a previous stroke, and poor physical function at the time of discharge from hospital increase the probability of a subsequent application for nursing care.

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ORIGINAL ARTICLE

Predictors of Dependency on Nursing Care After Stroke

Results From the Dortmund and Münster Stroke Registry

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eTABLE 1

Differences between study participants at baseline and participants for whom data on application for nursing care were available at 36-month follow-up

	Baseline participants n (%)	Participants with data on dependency on nursing care n (%)	p value
n	1552 (67.9)	734 (32.1)	
Men	732 (47.2)	438 (59.7)	p< .001
No children	168 (10.8)	83 (11.3)	p=0.730
Married	684 (44.1)	399 (54.4)	p<0.001
Age at baseline, mean (SD)	71.8 (13.1)	66.4 (11.5)	p<0.001
≤ 49 years	101 (6.5)	62 (8.5)	p<0.001
50:59 years	157 (10.1)	105 (14.3)	
60:69 years	294 (18.9)	265 (36.1)	
70:79 years	539 (34.7)	220 (30.0)	
≥ 80 years	461 (29.7)	82 (11.2)	
Home situation			
With partner	451 (51.3)	395 (68.2)	p<0.001
Living alone	285 (32.4)	131 (22.6)	
With family	82 (9.3)	47 (8.1)	
Institution	62 (7.1)	6 (1.0)	
Stroke type			
TIA	297 (19.1)	178 (24.3)	p=0.001
Cerebral ischemia	1 097 (70.7)	511 (69.6)	
Cerebral hemorrhage	94 (6.1)	29 (4.0)	
Other, unknown	64 (4.1)	16 (2.2)	

TIA, transient ischemic attack

eTABLE 2
Influence of complications during treatment on application for nursing care following a stroke

Complications during treatment		Number of patients (n)	Application made (n)	Proportion (%)	OR (95% CI)*
Urinary tract infection	–	708	155	21.9	3.81 (1.67–8.73)
	+	26	15	57.7	
Pneumonia	–	712	159	22.3	3.89 (1.60–9.42)
	+	22	11	50.0	
Previous stroke	–	715	161	22.5	3.30 (1.28–8.51)
	+	19	9	47.4	
Fall	–	723	164	22.7	3.71 (1.06–13.04)
	+	11	6	54.6	
Disorientation	–	716	157	21.9	9.33 (3.17–27.49)
	+	18	13	72.2	
Cerebral edema	–	729	168	23.1	4.07 (0.63–26.24)
	+	5	2	40.0	
Epileptic seizure	–	728	167	22.9	4.48 (0.88–22.74)
	+	6	3	50.0	
Cardiac decompensation	–	728	166	22.8	5.46 (0.96–31.10)
	+	6	4	66.7	
Number of complications				Per complication	2.92 (2.02–4.21)
0		647	126	19.5	1.00
1		68	32	47.1	3.55 (2.08–6.04)
≥ 2		19	12	63.2	7.19 (2.66–19.40)

OR, Odds ratio; 95% CI: 95% confidence interval; * adjusted for age and sex